REMARKS

Claims 1-15 and 33-38 are pending in the present application. Claims 16-32 are cancelled without prejudice or disclaimer. The specification is objected to under 37 C.F.R. § 1.71 because the Examiner alleges that the process and structure of displaying a florescence image throughout the specification lacks any additional explanation and understanding as to a proper interpretation of the claims. Claims 1-15 and 33-38 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. For clarity, Applicants amend the specification on page 52, as shown above.

Applicants submit that an aspect of the present invention is intended to solve a problem caused by an incident light flux of regularly reflected light. When the incident light flux of regularly reflected light hits a light detection area of an imaging device, the area may be displayed as diseased tissue regardless of whether the tissue is really diseased or not.

Conventionally, a tissue condition image, which represents a tissue condition, may be formed by various methods. The patentability of the present invention does not lie in the manner in which or the method by which the tissue condition image is formed.

Conventionally, an apparatus for displaying fluorescent images performs an operation between images, such as a captured fluorescent image and a reflected reference light image, so as to form a tissue condition image. In the tissue condition image, an area showing diseased tissue of a living body is represented in red. However, if an incident light flux of high intensity hits a light detection area of the imaging device and no processing is performed on the image, the area hit by the incident light flux of high intensity may also be displayed in red. This is because when

the incident light flux of high intensity hits the light detection area, performing the operation between the image data sets may give the results indicating that the tissue is diseased regardless of whether the tissue is really diseased or not.

For example, the value obtained by the operation may be a value of Fluorescent Intensity/Reflected Reference Light Intensity. In this case, the tissue condition is judged based on the magnitude of the value of Fluorescent Intensity/Reflected Reference Light Intensity. Therefore, if the reflected reference light intensity is high, the obtained value may become smaller than the threshold value, and thus the tissue is judged to be the diseased tissue. As a result, the area is displayed as diseased tissue, regardless of the actual tissue condition.

Returning to the Office Action, the Examiner states that:

> The issue is how are the multiple fluorescence images and the reflectance image, manipulated to arrive to the claimed tissue image. There is no specification support to arrive to this tissue image, nor to the arguments to clarify the rejections raised.

Applicants submit that there are supporting descriptions in the specification which show the process of forming the tissue condition image.

For convenience of the Examiner, Applicants submit Attachment I which provide a listing of the exemplary sections which support the process of forming the tissue condition image. Attachment I also includes photocopies of the originally filed specification with the exemplary sections underlined. In particular, Applicants point out the underlined section "G" on line 22, page 52 - line 21, page 53 of the specification which show how the tissue condition image signal DD is obtained. In addition to the descriptions in the specification set forth in the

Attachment I, Fig. 1 shows Dn, Dk, Dm, Dsh, Dss and DD which indicate various image data signals.

From the above, one skilled in the art would fully understand the process of forming the tissue condition image in the first embodiment with reference to Fig. 1. Further, one skilled in the art would fully understand the process of forming the tissue condition image in the second embodiment with reference to Fig. 9.

In addition, Applicants also submit that the sections of the Specification previously referred to in the Amendment of December 22, 2003, show that "a value of the narrow-band fluorescence image ... is divided by the value of the broad-band fluorescence image" to obtain a "normalized fluorescence intensity." Line 23, page 71 - line 2, page 72. Then the "value of the normalized fluorescence intensity is transformed into chrominance signal components" with reference to a color look-up table. Lines 5-6, page 72. Further, "the value of the IR reflected reference light image . . . is transformed into a luminance signal component," with reference to a luminance look-up table. Lines 15-21, page 72. With chrominance and luminance signals, it is well known in the art that an image can be formed. Therefore, an image representing the tissue condition image can be easily formed from the chrominance and luminance signals received at the tissue condition image forming section 733. Line 23, page 72 - line 1, page 73.

Moreover, Applicants submit that claims 33-38 specifically recite how the luminance and chrominance signals are obtained from first and second fluorescence images and reflected reference light.

As for the Examiner's assertion regarding the use of the terms "accurate" and "inaccurate" in the specification, and for other issues raised in the Final Office Action, Applicants refer the Examiner to the arguments presented in the Amendment of December 22, 2003. Applicants also submit that, for the first embodiment, one skilled in the art would understand the use of "accurate" and "inaccurate," by referring to Figs. 5A, 5B, 5C, 6 and 7, as well as corresponding descriptions in the specification. Regarding the second embodiment, one skilled in the art would understand the use of the two terms in the context of Figs. 11 and 12, as well as the corresponding descriptions in the specification.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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ATTACHMENT I

Supporting descriptions of the "process of forming the tissue condition image" according to the first embodiment of the present invention

Locations of the descriptions A to G are marked in the specification.

(A) Relationships of the first fluorescence image, the reflected reference light image and the tissue condition image with each of the corresponding image data signals (Refer to A on page 40.)

(B) Obtainment of the reflected reference light image Zn, the surface sequential light image Zm and the fluorescence image Zk (Refer to B on page 45.)

(C) Descriptions of the reflected reference light image Zn, the surface sequential light image Zm and the fluorescence image Zk (Refer to C on pages 46, 47.)

(D) Obtainment of the regularly reflected light area signal Dsh representing an area having a markedly high intensity, i.e., an intensity higher than a predetermined threshold value (The area is an abnormal light-receiving area.) (Refer to D on page

50.)

(E) Obtainment of the fluorescence yield image signal Dss (Refer to E on pages 50, 51.)

(F) Illustration of the regularly reflected light area signal Dsh, the fluorescence yield image signal Dss and the surface sequential light image signal Dm in FIGS. 5A - 5C (Refer to F on page 52.)

(G) Composition of the three kinds of data (Refer to G on pages 52, 53.)

Supporting descriptions of the "process of forming the tissue condition image" according to the second embodiment of the present invention

Locations of the descriptions H to O are marked in the specification.

(H) Introduction of the first fluorescence image, the second fluorescence image, and the reflected reference light image according to the second embodiment (Refer to H on page 57.)

(I) Operation and transformation between the narrow-band fluorescence image and the broad-band fluorescence image and

transformation of the IR reflected reference light image (Refer to I on page 64.)

(J) Operation and transformation between the narrow-band fluorescence image and the broad-band fluorescence image (Please refer to J on pages 71, 72.)

(K) Transformation of the IR reflected reference light image (Refer to K on page 72.)

(L) Formation of the tissue condition image (Refer to L on pages 72, 73.)

Note: Conventionally, a chrominance signal and a luminance signal are combined and an image produced thereby is displayed on an image monitor. Further, signal processing is always required for displaying the image. Since the aforementioned tissue condition image is a kind of the images displayed on a display device, one skilled in the art should easily recognize that the tissue condition image displayed on the image monitor was produced by combining the chrominance signal and the luminance signal.

(M) Description related to display of the tissue condition image (Refer to M on page 78.)

(N) Description related to display of the tissue condition image

(Refer to N on page 79.)

(O) Description related to display of the tissue condition image

(Refer to O on pages 79, 80.)

in further detail with reference to the accompanying drawings.

Figure 1 is a schematic view showing a fluorescence endoscope system, in which a first embodiment of the apparatus for displaying a fluorescence image in accordance with the present invention is employed.

In a fluorescence endoscope system 800, in which the first embodiment of the apparatus for displaying a fluorescence image in accordance with the present invention is employed, operation processing is performed on a fluorescence image signal Dk and a reflected reference light image signal Dn. The fluorescence image signal Dk represents a first fluorescence image having been obtained by detecting fluorescence components of fluorescence having been produced from living body tissues 1 exposed to excitation light Le, which fluorescence components have wavelengths falling within a specific wavelength region. The reflected reference light image signal Dn represents a reflected reference light image having been obtained by detecting reflected reference light, which has been reflected from the living body tissues 1 when reference light Ln is irradiated to the living body tissues 1. With the operation processing, a tissue condition image signal DD representing a tissue condition image, which represents a tissue condition of the living body tissues 1 and which has been compensated for a distance to the living body tissues 1, is formed. In cases where the tissue condition image represented by the tissue condition image signal DD is to displayed, a judgment is made as to whether each of image areas embedded in the tissue

condition image represented by the tissue condition image signal DD is an abnormal light affected area, which has been affected by light having an intensity equal to at least a specified value, or a normal light detection area, which has been formed with light having an intensity lower than the specified value. The judgment is made by a regularly reflected light area recognizer 41, which acts as the judgment means, and in accordance with either one of the first fluorescence image, which is represented by the fluorescence image signal Dk, and the reflected reference light image, which is represented by the reflected reference light image signal Dn. In accordance with an output of the regularly reflected light area recognizer 41 acting as the judgment means, a tissue condition image composer 45, which acts as the abnormal light affected area displaying means, displays the abnormal light affected area in a form different from the normal light detection area. The specified value is determined in accordance with an intensity of the reflected reference light, which intensity indicates the presence of regularly reflected light, in the reflected reference light image signal Dn. The abnormal light affected area, which has been affected by light having an intensity equal to at least the specified value, is judged as being a regularly reflected light area.

With reference to Figure 1, the fluorescence endoscope system 800 comprises a light source unit 100 provided with two light sources for producing light having wavelengths falling within different wavelength regions. The fluorescence endoscope

end face 21a of the irradiating optical fiber 21, are guided through the irradiating optical fiber 21, radiated out from an end face 21b of the irradiating optical fiber 21, and irradiated through an irradiating lens 22 to the living body tissues 1.

An image of the living body tissues 1, which is formed with reflected reference light having been reflected by the living body tissues 1 when the reference light Ln is irradiated to the living body tissues 1, and an image of the living body tissues 1, which is formed with reflected surface sequential light having been reflected by the living body tissues 1 when the surface sequential light Lm is irradiated to the living body tissues 1, are formed by an objective lens 23 and on a light receiving surface of an image sensor 25. (The image formed with the reflected reference light will hereinbelow be referred to as the reflected reference light image Zn. Also, the image formed with the reflected surface sequential light will hereinbelow be referred to as the surface sequential light image Zm.) The reflected reference light image Zn and the surface sequential light image Zm are detected and converted by the image sensor 25 into electric image signals. The electric image signals are transmitted through a cable 26 into the relay unit 300. Also, a fluorescence image Zk formed with the fluorescence, which has been produced from the living body tissues 1 when the excitation light Le is irradiated to the living body tissues 1 and which has wavelengths falling within a wavelength region of a value longer than 410nm to a value in the vicinity of 700nm, is formed by the objective lens 23 and

on the light receiving surface of the image sensor 25. The fluorescence image Zk is detected and converted by the image sensor 25 into an electric image signal. The thus obtained electric image signal is transmitted through the cable 26 into the relay unit 300. An excitation light cut-off filter 24, which filters out light having a wavelength of 410nm and transmits only light having wavelengths falling within the wavelength region longer than 410nm, is located between the objective lens 23 and the image sensor 25. Reflected excitation light (i.e., reflected light of the excitation light), which is mixed in the fluorescence image Zk and has impinged upon the objective lens 23, is filtered out by the excitation light cut-off filter 24.

The relay unit 300 comprises an analog-to-digital converter 31 for converting each of the image signals, which have been transmitted through the cable 26, into a digital image signal. The relay unit 300 also comprises a reflected reference light image memory 32 for storing the two-dimensional image signal, which represents the reflected reference light image Zn and has been received from the analog-to-digital converter 31, as the reflected reference light image signal Dn. The relay unit 300 further comprises a fluorescence image memory 33 for storing the two-dimensional image signal, which represents the fluorescence image Zk and has been received from the analog-to-digital converter 31, as the fluorescence image signal Dk. The relay unit 300 still further comprises a surface sequential light image memory 34 for storing the two-dimensional image signal, which represents the

surface sequential light image Zm and has been received from the analog-to-digital converter 31, as a surface sequential light image signal Dm.

The operation processing unit 400 comprises the regularly reflected light area recognizer 41 for receiving the reflected reference light image signal Dn and recognizing a regularly reflected light area having been affected by regularly reflected light, which area is embedded in the image represented by the reflected reference light image signal Dn. A regularly reflected light area signal Dsh, which represents the recognized regularly reflected light area, is obtained from the regularly reflected light area recognizer 41. The operation processing unit 400 also comprises a regularly reflected light area memory 42 for storing the regularly reflected light area signal Dsh having been received from the regularly reflected light area recognizer 41. The operation processing unit 400 further comprises a fluorescence yield calculator 43 for receiving the reflected reference light image signal Dn and the fluorescence image signal Dk and forming a fluorescence yield image signal Dss, which represents the tissue condition of the living body tissues 1, from the received signals. The operation processing unit 400 still further comprises a fluorescence yield image memory 44 for storing the fluorescence yield image signal Dss having been received from the fluorescence yield calculator 43. The regularly reflected light area signal Dsh having been stored in the regularly reflected light area memory 42, the fluorescence yield image signal Dss

the surface sequential light image Zm is stored in the surface sequential light image memory 34.

The reflected reference light image signal Dn, which represents the reflected reference light image Zn and has been stored in the reflected reference light image memory 32, is fed into the regularly reflected light area recognizer 41. In the regularly reflected light area recognizer 41, a pixel area represented by the reflected reference light image signal Dn, which area corresponds to an area having a markedly high intensity in the reflected reference light image Zn, i.e. a pixel area Z having an intensity higher than a predetermined threshold value Q among the intensities at respective pixel positions as illustrated in Figure 4, is recognized as the regularly reflected light area. The regularly reflected light area signal Dsh representing the recognized regularly reflected light area is stored in the regularly reflected light area memory 42.

Also, the reflected reference light image signal Dn, which represents the reflected reference light image Zn and has been stored in the reflected reference light image memory 32, and the fluorescence image signal Dk, which represents the fluorescence image Zk and has been stored in the fluorescence image memory 33, are fed into the fluorescence yield calculator 43. In the fluorescence yield calculator 43, signal values of the fluorescence image signal Dk and the reflected reference light image signal Dn, which signal values represent corresponding pixels in the fluorescence image Zk and the reflected reference

light image Zn, are divided by each other (i.e., the ratio of the signal value of the fluorescence image signal Dk to the signal value of the reflected reference light image signal Dn is calculated), and the fluorescence yield image signal Dss is thereby obtained. Specifically, the division represented by the formula shown below is performed with respect to each of the pixels, and the values of the fluorescence yield image signal Dss are calculated.

$$Dss=Dk/Dn$$

The fluorescence yield image signal Dss is equivalent to a two-dimensional image signal representing the fluorescence yield that is the ratio of the intensity of the fluorescence, which has been produced from the living body tissues 1 when the excitation light Le is irradiated to the living body tissues 1, to the intensity of the excitation light Le, which is received by the living body tissues 1. Specifically, since it is not easy to directly measure the distribution of the intensity of the excitation light Le, which is received by the living body tissues 1, the distribution of the intensity of the reflected reference light having been reflected by the living body tissues 1 is utilized in lieu of the distribution of the intensity of the excitation light Le, which is received by the living body tissues 1, and the fluorescence yield is thereby calculated. The fluorescence yield image signal Dss is stored in the fluorescence yield image memory 44.

Thereafter, the regularly reflected light area signal

Dsh, the fluorescence yield image signal Dss, and the surface sequential light image signal Dm, which have been obtained in the manner described above, are fed into the tissue condition image composer 45. As illustrated in Figure 5A, the regularly reflected light area signal Dsh represents areas P1 and P2, at which the reference light Ln has been regularly reflected from the living body tissues 1. The fluorescence yield image signal Dss represents the tissue condition of the living body tissues 1. Specifically, as illustrated in Figure 5B, the fluorescence yield image signal Dss represents diseased tissue areas P3 and P4. The fluorescence yield image signal Dss also contains signal components representing areas P1' and P2', which have been affected by the regularly reflected light and are displayed in a form approximately identical with the form of the diseased tissues due to the effects of the regularly reflected light. As illustrated in Figure 5C, the surface sequential light image signal Dm represents the color and the shape of the living body tissues 1, which color and shape are seen ordinarily. In Figure 5C, P5 and P6 are the areas, which appear as luminous points due to the regular reflection of the surface sequential light Lm from the living body tissues 1.

As illustrated in Figure 6, when the three kinds of the signals described above are fed into the tissue condition image composer 45, the image, in which the areas P3 and P4 having been recognized as the diseased tissue areas in accordance with the fluorescence yield image signal Dss have been embedded, (i.e.,

the image in which the normal tissue areas have values close to 0 and the diseased tissue areas have large values) is added onto the living body tissue image, which is ~~an ordinarily seen image and~~ is represented by the surface sequential light image signal Dm, ~~(i.e., the image in which the bright areas have values close to 0 and the dark areas have large values)~~. Also, an image is composed as illustrated in Figure 7. In the composed image illustrated in Figure 7, the areas corresponding to the areas P1 and P2 represented by the regularly reflected light area signal Dsh, i.e. the areas overlapping upon the areas P5 and P6 represented by the surface sequential light image signal Dm and the areas P1' and P2' represented by the fluorescence yield image signal Dss, are displayed in specific regularly reflected light area displaying forms F1 and F2, which have been determined previously, (i.e., in the displaying forms in which the peripheries of the areas have protrusions and the insides of the areas are dark), such that the areas corresponding to the areas P1 and P2 are capable of being clearly discriminated from the regions P3 and P4, which have been recognized as being the diseased tissue areas. From the tissue condition image composer 45, the tissue condition image signal DD representing the composed image is obtained.

The tissue condition image signal DD is transformed by the video signal processing circuit 46 into video signals. The video signals are fed from the operation processing unit 400 into the display device 500 and utilized for displaying a visible image. The specific regularly reflected light area displaying

to colposcopes, operating microscopes, and the like.

A fluorescence endoscope system, in which a second embodiment of the apparatus for displaying a fluorescence image in accordance with the present invention is employed, will be described hereinbelow with reference to Figure 9.

In a fluorescence endoscope system 900, in which the second embodiment of the apparatus for displaying a fluorescence image in accordance with the present invention is employed, operation processing is performed on a narrow-band fluorescence image, a broad-band fluorescence image, and an IR reflected reference light image. The narrow-band fluorescence image is a second fluorescence image having been obtained by detecting fluorescence components of fluorescence having been produced from living body tissues exposed to excitation light, which fluorescence components have wavelengths falling within a specific wavelength region of 430nm to 530nm. The broad-band fluorescence image is a first fluorescence image having been obtained by detecting fluorescence components of the fluorescence, which fluorescence components have wavelengths falling within a wavelength region of 430nm to 730nm different from the specific wavelength region described above. The IR reflected reference light image is a reflected reference light image having been obtained by detecting light components of light having been reflected from the living body tissues when white light containing near infrared light acting as reference light is irradiated to the living body tissues, which light components have wavelengths

falling within a near infrared wavelength region of 750nm to 900nm. With the operation processing, a tissue condition image, which represents a tissue condition of the living body tissues and which has been compensated for a distance to the living body tissues, is formed. In cases where the tissue condition image is to displayed, a judgment is made as to whether each of image areas embedded in the tissue condition image is an abnormal light affected area, which has been affected by light having an intensity equal to at least a specified value, or a normal light detection area, which has been formed with light having an intensity lower than the specified value. The judgment is made by an image judgment unit 780, which acts as the judgment means, and in accordance with the narrow-band fluorescence image acting as the second fluorescence image, the broad-band fluorescence image acting as the first fluorescence image, and the IR reflected reference light image acting as the reflected reference light image. In accordance with an output of the image judgment unit 780, an image composer 790, which acts as the abnormal light affected area displaying means, displays the abnormal light affected area in a form different from the normal light detection area. The specified value is determined in accordance with a limit of detection in the IR reflected reference light image and limits of effective measurement ranges in the narrow-band fluorescence image and the broad-band fluorescence image.

With reference to Figure 9, the fluorescence endoscope system 900 comprises an endoscope tube 700 to be inserted into

The tissue condition image forming unit 730 comprises an image memory 727 for storing three kinds of image signals (representing the narrow-band fluorescence image, the broad-band fluorescence image, and the IR reflected reference light image), which have been detected through the rotating filter 722 and have been digitized by the analog-to-digital converting circuit 726. The tissue condition image forming unit 730 also comprises a color operation processing section 731 for performing a division between the two kinds of the fluorescence images (i.e., calculating the ratio between the two kinds of the fluorescence images) to find the normalized fluorescence intensity, finding correspondence relationship between the value of the normalized fluorescence intensity and a color by utilization of a look-up table having been stored previously, and transforming the value of the normalized fluorescence intensity into chrominance signals for the displaying of the visible image. The tissue condition image forming unit 730 further comprises a luminance operation processing section 732 for finding correspondence relationship between the value of the IR reflected reference light image and a luminance by utilization of a look-up table having been stored previously, and transforming the value of the IR reflected reference light image into a luminance signal for the displaying of the visible image. The tissue condition image forming unit 730 still further comprises a tissue condition image forming section 733 for forming the tissue condition image from the chrominance signals and the luminance signal, and a tissue

condition image memory 734 for storing the image signal representing the tissue condition image.

Though not shown, the image memory 727 is constituted of a narrow-band fluorescence image storing region, a broad-band fluorescence image storing region, and an IR reflected reference light image storing region. The fluorescence image, which has been detected with the broad band-pass filter 722A being located in the optical path when the excitation light J2 is irradiated to the living body tissues 1, is converted by the analog-to-digital converting circuit 726 into the digital value, and the thus obtained image signal representing the broad-band fluorescence image is stored in the broad-band fluorescence image storing region. Also, the fluorescence image, which has been detected with the narrow band-pass filter 722B being located in the optical path when the excitation light J2 is irradiated to the living body tissues 1, is converted by the analog-to-digital converting circuit 726 into the digital value, and the thus obtained image signal representing the narrow-band fluorescence image is stored in the narrow-band fluorescence image storing region. Further, the IR reflected reference light image, which has been detected with the IR band-pass filter 722C being located in the optical path when the white light J1 is irradiated to the living body tissues 1, is converted by the analog-to-digital converting circuit 726 into the digital value, and the thus obtained image signal representing the IR reflected reference light image is stored in the IR reflected reference light image storing region.

the binning reading operation, signal values of 5×5 pixels are added together, and the thus obtained sum is read. The thus obtained image signals are converted by the analog-to-digital converting circuit 726 into digital signals. The digital signal representing the broad-band fluorescence image is stored in the broad-band fluorescence image storing region of the image memory 727. Also, the digital signal representing the narrow-band fluorescence image is stored in the narrow-band fluorescence image storing region of the image memory 727. In cases where the binning reading operation is performed, the fluorescence image of a weak light intensity is capable of being detected accurately. However, with the binning reading operation, the number of the pixels constituting the image having been detected becomes equal to 100×100 pixels, i.e. 1/25 as large as the number of the pixels obtained in cases where the ordinary reading operation is performed.

How the composed image is formed will be described hereinbelow.

Firstly, the color operation processing section 731 of the tissue condition image forming unit 730 receives the image signals representing the narrow-band fluorescence image and the broad-band fluorescence image from the image memory 727. In the color operation processing section 731, the value of the narrow-band fluorescence image, which value represents a pixel in the narrow-band fluorescence image, is divided by the value of the broad-band fluorescence image, which value represents the

corresponding pixel in the broad-band fluorescence image. In this manner, the normalized fluorescence intensity is calculated. Also, reference is made to a color look-up table having been stored previously in the color operation processing section 731, and the value of the normalized fluorescence intensity is transformed into chrominance signal components. Thereafter, the chrominance signal components corresponding to one pixel are transformed into chrominance signal components corresponding to 5×5 pixels. In this manner, the number of the pixels is restored from 100×100 pixels to 500×500 pixels, and the chrominance signals representing 500×500 pixels are obtained.

The luminance operation processing section 732 receives the image signal representing the IR reflected reference light image, which image signal has been stored in the IR reflected reference light image storing region of the image memory 727. In the luminance operation processing section 732, reference is made to a luminance look-up table having been stored previously in the image memory 727, and the value of the IR reflected reference light image, which value represents each pixel in the IR reflected reference light image, is transformed into a luminance signal component. The luminance signal made up of the thus obtained luminance signal components is obtained.

The tissue condition image forming section 733 receives the chrominance signals and the luminance signal described above and forms the image signal, which represents the tissue condition

image, from the received signals. The image signal representing the tissue condition image is stored in the tissue condition image memory 734.

How the image judgment unit 780 and the image composer 790 operate will be described hereinbelow.

As described above, the image signals, which represent the narrow-band fluorescence image, the broad-band fluorescence image, and the IR reflected reference light image and which have been obtained from the analog-to-digital conversion performed by the analog-to-digital converting circuit 726, are fed into the image memory 727. Also, the image signals, which represent the narrow-band fluorescence image, the broad-band fluorescence image, and the IR reflected reference light image, are respectively fed into the effective measurement range judging device 781, the effective measurement range judging device 782, and the overflow judging device 783.

The image signal representing the narrow-band fluorescence image, which image signal has been fed into the effective measurement range judging device 781, and the image signal representing the broad-band fluorescence image, which image signal has been fed into the effective measurement range judging device 782, are compared with the specified values, which have been determined in accordance with the limits of the effective measurement ranges. In this manner, transfinite areas are determined. The specified values are determined previously with the techniques described below and stored in the effective

and the transfinite areas U3, U3, ... have been acquired respectively from the effective measurement range judging device 781, the effective measurement range judging device 782, and the overflow judging device 783 by making reference to the corresponding specified values. When the images H1, H2, and H3 are fed into the abnormal light affected area judging device 784, a logical product of the transfinite areas U1, U1, ..., the transfinite areas U2, U2, ..., and the transfinite areas U3, U3, ... embedded in the images H1, H2, and H3 is calculated, and abnormal light affected areas U4, U4 are thereby determined. The information representing the positions of the abnormal light affected areas U4, U4, which have been determined by the abnormal light affected area judging device 784, is stored in the abnormal light affected area memory 785.

The image composer 790 receives the information representing the positions of the abnormal light affected areas U4, U4, which information has been stored in the abnormal light affected area memory 785, and the image signal representing the tissue condition image, which image signal has been stored in the tissue condition image memory 734. As illustrated in Figure 12, the image composer 790 forms the composed image, such that abnormal light affected areas U4', U4' may be illustrated as white areas in a tissue condition image S, which is displayed as a color image.

An image signal representing the thus composed image is fed from the image composer 790 into the video signal forming

circuit 744. The image signal representing the composed image is transformed by the video signal forming circuit 744 into the video signals, and the video signals are utilized for displaying a visible composed image on the video monitor 770. The series of the operations described above are controlled by the controller 750.

The video signal forming circuit 744 performs both the signal processing on the composed image and the signal processing on the ordinary image, which is fed from the ordinary image memory 743.

In the visible composed image, which is displayed in the manner described above, the color represents the normalized fluorescence intensity, i.e. the diseased state of the living body tissues 1. Also, the luminance represents the intensity of the light having been reflected from the living body tissues 1, i.e. the shape of the living body tissues 1. Therefore, the information concerning the diseased state of the living body tissues 1 and the information concerning the shape of the living body tissues 1 are capable of being illustrated together on a single image.

Also, the abnormal light affected area, at which the tissue condition of the living body tissues 1 is not illustrated accurately, is illustrated as the white area in the image, which is displayed as the color image on the video monitor 770 and which represents the tissue condition of the living body tissues 1. Therefore, the problems are capable of being prevented from

occurring in that the person, who sees the displayed image, makes an incorrect diagnosis by mistake. Accordingly, the tissue condition of the living body tissues 1 is capable of being seen with a high reliability.

Further, since the GaN type of semiconductor laser 714 is employed as the light source for producing the excitation light J2, the irradiation of the excitation light J2 is capable of being performed with the cheap, small-sized light source. Furthermore, since the wavelength of the excitation light J2 is 410nm, the fluorescence is capable of being produced efficiently from the living body tissues 1.

In lieu of the normalized fluorescence intensity being utilized, the value of the fluorescence yield may be calculated by dividing the value of the pixel in the broad-band fluorescence image by the value of the corresponding pixel in the IR reflected reference light image. The value of the fluorescence yield may be allocated to the chrominance signal components. Also, the value of the pixel in the IR reflected reference light image may be allocated to the luminance signal component. In this manner, the tissue condition image may be formed.

Also, in the tissue condition image forming unit 730, the tissue condition image represented by the chrominance signals and the luminance signal need not necessarily be formed by utilizing both the color operation processing section 731 and the luminance operation processing section 732. For example, instead of the color operation processing section 731 being utilized, the value